JPRS 80302

11 March 1982

East Europe Report

SCIENTIFIC AFFAIRS

No. 734

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 80302

11 March 1982

EAST EUROPE REPORT

SCIENTIFIC AFFAIRS

No. 734

CONTENTS

BULGARIA

Report on Instruments Used in Earth Studies From Space
(Dimitur Mishev; SPISANIE NA BULGARSKATA AKADEMIYA NA NAUKITE, No 3, 1981) 1

Report on New Technologies
(SPISANIE NA BULGARSKATA AKADEMIYA NA NAUKITE, No 3, 1981) 8

Further Report on New Technologies
(SPISANIE NA BULGARSKATA AKADEMIYA NA NAUKITE, No 4, 1981) 13

CZECHOSLOVAKIA

Cooperation in Joint Institute of Nuclear Research Described
(Frantisek Becvar, et al; POKROKY MATEMATIKY, FYZIKY A ASTRONOMIE, No 5, 1981) 17

Briefs
Heating From Nuclear Plants 35

YUGOSLAVIA

Croatian Official Discusses Science, Technology Lag
(Nino Pavic; VJESNIK, 13 Feb 32) 36

REPORT ON INSTRUMENTS USED IN EARTH STUDIES FROM SPACE

Sofia SPISANIE NA BULGARSKATA AKADEMIYA NA NAUKITE in Bulgarian No 3, 1981 pp 77-83

[Article by Prof Dimitur Mishev: "'Spektur 15' Aboard the 'Salyut-Soyuz' Manned Orbital Scientific Research Complex"]

[Text] In connection with the flight of the international crew involving the first Bulgarian cosmonaut Georgi Ivanov, a scientific program and proper equipment for the telemetric study of earth from outer space had to be developed. This is one of the lines followed in space research, in which our country traditionally has been working and in which it has achieved some success and recognition. Let me point out that the telemetric observation of earth from outer space means observations and measurements of energy and polarizing characteristics of specific and reflected radiation of the earth's land, oceans and atmosphere in the various ranges of the electromagnetic spectrum, which help to determine the location, nature and temporal variability (dynamic) of natural parameters and phenomena, the earth's natural resources, the environment and anthropogenic sites and formations.

The scientific program of the flight of Col Engineer G. Ivanov included the following studies and experiments: Balkan, Contrast, Atmosphere, Horizon, Dawn, Porthole, Halo and Biosphere-B. Let us describe briefly the basic research assignments.

Balkan. Simultaneous spectrometry and multiple-spectral photography of homogeneous land and water surfaces. This was accomplished with the help of the multiple-channel Spektur 15 spectrometric system developed by Bulgarian scientists and the multizonal MKF-6M photographic camera developed by scientists from the USSR and the GDR. The objective was the following:

Obtaining multispectral data for the various sciences and economic sectors;

Modeling some future studies with complex scientific equipment for the B-1300-2 project;

Developing methods for the coordination of simultaneously obtained spectrometric data and multizonal images and their processing.

Contrast. Despite the steps taken to reduce atmospheric pollution, the problem of pollutants which occasionally reach dangerous concentrations (particularly those close to large industrial centers) is becoming serious. The rapid development of transportation systems and the intensive growth of industry are raising the level of atmospheric and water pollution and particularly that in large centers of modern civilization. So-called "pollution domes" appear.

Studies are underway of changes in the transmission function of the atmosphere depending on its level of pollution over large industrial centers not far from water basins. This is conducted with the help of the Spektur 15 multichannel system and a camera with polarizing filters.

The main scientific tasks are the following:

Study of changes in the frequency characteristics of the transmission function of the atmosphere according to atmospheric pollution data;

Study of spectral deviations of the transmission function in different types of pollution;

Study of pollution dynamics of coastal waters caused by industrial waste carried by the currents;

Grading large centers by type and structure of pollutants and comparing the spectra of their transmission functions;

Study of the possibility of breaking down basic pollutants by type according to their influence on the spectral optical characteristics of the atmosphere, etc.

Atmosphere. The characteristics of solar radiation and the radiation of natural formations are used in the study of natural resources on earth from outer space. Since solar radiation and the radiation of earth objects are transformed as they cross the atmosphere, the influence of the atmosphere and atmospheric effects must be taken into consideration in the study of natural formations (and resources) from outer space. The transformation of radiation in the atmosphere is related to the absorption and dispersion of electromagnetic waves as atmospheric gas components and aerosol particles. These processes change the spectral, angular and spatial dispersion of radiation. Furthermore, as a result of the dispersion and the radiation of the atmosphere itself, a background is added to the radiation or reflective radiation of objects, which also distort the spectral, angular and spatial structure of the initial signal of the studied target and which also provide information on the atmosphere itself. Atmospheric effects can be determined with the transmission function of the atmosphere.

The purpose of such studies is the following:

To determine the transmission function of the atmosphere from outer space;

To study the optical characteristics of the atmosphere on the basis of the determination of the angular structure of radiation of the spectral reflection coefficient of the earth and the measurement of the reflected solar radiation from the earth's surface at two points symmetrical in terms of their nadir.

The studies are conducted with the multichannel spectrometric Spektur 15 system. A possible deviation of its optical axis by ±10° compared to the nadir on the level of the flight is considered.

Horizon. The purpose is to study the optical characteristics of the earth's atmosphere based on the spectral programs of the setting sun and the terminator zone.

The scientific tasks of such studies are the following:

To study the possibility of determining the transmission function of the atmosphere based on spectrometric data of the setting sun until the sun has entirely disappeared over the horizon;

To study the spectral characteristics and the indicators of the dispersal of the light from the earth's atmosphere based on data obtained by Spektur 15 in the area of the terminator in nadir.

Such studies are conducted with the help of Spektur 15.

Dawn. The purpose is to study solar radiation dispersed by the atmosphere during sunrise or sunset and to obtain important data from the atmospheric structure. Furthermore, the coefficient of atmospheric permeability must be computed and the earth's horizon at sunset and during the night must be analyzed spectrometrically.

The Spektur 15 system is used for these purposes and the station is oriented in the direction of the sun.

The study known as Terminator was conducted with the help of the Spektur 15 system in some flights of international crews based on the Intercosmos system (such as Vietnam, Mongolia, etc). The purpose was to study the optical characteristics of the atmosphere based on spectrometric data in the terminator zone.

Porthole. We know that the information obtained from the study of the earth and the processes around the earth from outer space is unique. However, such observations are complicated by conditions prevailing in outer space. For example, some cosmonauts have noted a darkening of the portholes immediately after the space ship was put into orbit. This means that the data obtained and recorded aboard the ship through the portholes of Salyut 6 were somewhat distorted. This prevents the quantitative processing of the data and of multizonal images and greatly reduced the effectiveness of their use for scientific and economic purposes.

The Bulgarian scientists suggested a method for determining the optical characteristics of a randomly selected porthole with the help of the multichannel Spektur 15 spectrometric system.

The scientific assignments of this study are the following:

To determine the spectral coefficient of transparency of the portholes in space flight;

To determine the dynamics of change of the spectral transparency coefficient during long flights;

To correct obtained data and multichannel images obtained aboard the Soyuz 6, taking into consideration the real effect of the respective portholes;

To use such data in designing the portholes of subsequent orbital stations.

Halo and Biosphere-B, which are the last two groups of studies, are not directly related to the Spektur 15 multichannel system, for which reason we shall not discuss them in this article.

The Spektur 15 multichannel spectrometric system was developed, built and delivered after a complex cycle of testing by a Soviet acceptance commission for use in the large and important scientific program being implemented in the area of telemetric studies of the earth from outer space. The system is a product of Bulgarian science and technology. Its purpose is to obtain and record data concerning the properties and effects of radiation within the visible and close infrared range of the electromagnetic spectrum, whether specific or reflected by various natural formations and the atmosphere. It permits the operating cosmonaut to make verbal comments and to record sound signals digitally (through delta modulation).

The system consists of the following installations: Spektur 15 K and Spektur 15 KR.

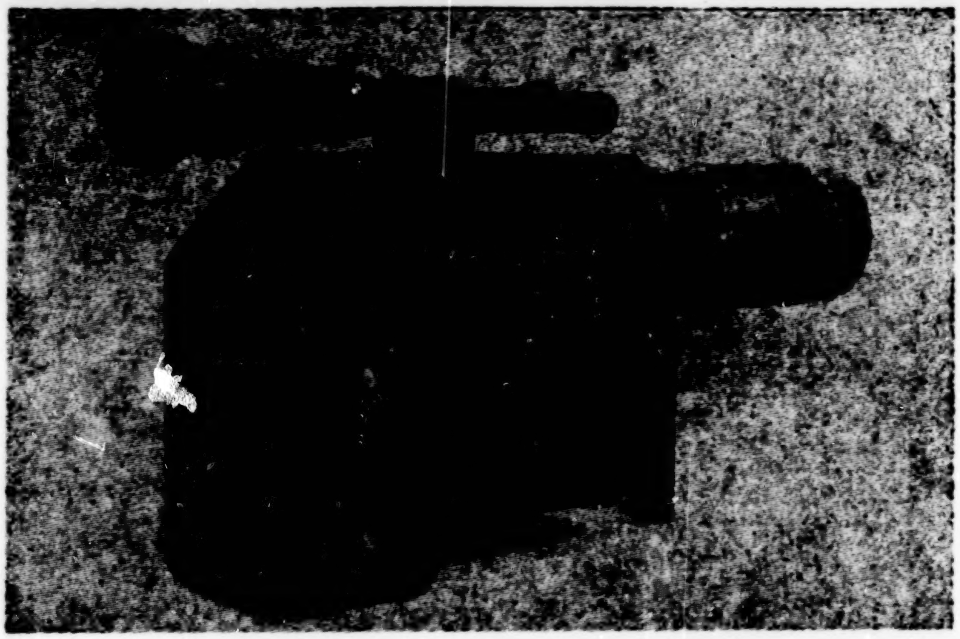
Spektur 15 K is a multichannel spectrometer with a digital output. It has 15 channels with a 20 nm band width. A lens with a 300 mm focal distance, 1:4 aperture and 8° angle of vision is used. The dispersal system is a reflecting diffraction grid (600 lines per mm). It is used for the optical electronic transformation of the linear semiconductor structure with phototransistors which operate under a charge accumulation system. The scanning along the wavelength is electronic; along the length of the flight it is achieved by the motion of the space ship. The analog-digital conversion time is under 20 micron seconds. An 8-grade code is used. Spektur 15 K can be secured to the porthole of the Salyut 6 orbital station with a special braket or else held by the cosmonaut. The bracket is so designed as to allow changes in the position of the instrument on the level of the flight at ±10° of the nadir. This makes possible the studies planned for the Atmosphere series: eliminating the influence of the repeated dispersal in the atmosphere and determining the reflection indicator. If the instrument is secured to the porthole, the optical axis of the lens and the aim of the Spektur 15 K become coincident with the main optical axis of the IKF-6M multichannel camera (this is necessary for the studies of the Balkan series and for correcting some specific effects of recording the images by the MKF-6M). The initial models made it possible to change the reaction to light with the shade of the lens up to 32 times. Light overloading is indicated by a flashing light on the control panel and the viewfinder of Spektur 15 K.

Spektur 15 KR is used in registering digital data received through the input bars, control of all work systems of the digital cassette recorder, the analog-digital transformation of the sound signal and connection and synchronized work with the control and measuring equipment (KIA). It contains the second power block of the entire system. The digital data are recorded on magnetic tape at the speed of 8 K bits per second with a recording accuracy of no more than one error per 10^7 bit.

A working copy for the preflight training of the crews was developed along with the Spektur 15 system. It was installed by Bulgarian specialists in the simulator of the Salyut 6 orbital complex at the end of 1978 and is still being used in the training of Soviet and international crews.

In February 1979 the Soviet state acceptance commission accepted the Spektur 15 flight and spare sets. The system consists of separate blocks which could be put into orbit separately and subsequently assembled and tuned on board the Salyut-Soyuz orbital complex. The Spektur 15 KR block, lens, optical sight, bracket and neutral fliters were put in orbit with the Progres 5 transport ship in March 1979 (the ship was launched on 12 March 1979 at 0847 hours and linked with Salyut 6 on

14 March 1979 at 1020 hours). The remaining parts, such as the Spektur 15 K system and the digital data recording cassettes were carried by cosmonauts N. Rukavishnikov and G. Ivanov in the Soyuz 33 space ship. Considering the dramatic circumstances of the heroic flight of the night of 11 April 1979, the decision was made at the Flight Control Center that the other systems would not be brought down to earth, for which reason a new Spektur 15 K system, compatible with the remaining complex blocks of the system aboard the Salyut 6, had to be made within an extremely short time. All remaining blocks were put in orbit in May 1979 with the Progres 6 transport ship (launched on 13 May 1979 at 0717 hours, and linked with Salyut 6 on 15 May 1979 at 0919 hours). The Spektur 15 multichannel spectrometric system was assembled, tuned and made ready for work in orbit in a short time. This was accomplished by cosmonauts V. Lyakhov and V. Ryumin. In implementing their international duty, they undertook the fulfillment of the complex scientific program which had been drafted for the Rukavishnikov-Ivanov flight. Studies within the Contrast and Terminator series were conducted on 27 June 1979 during the 10,049th orbit of the Salyut-Soyuz scientific complex; on the following day--28 June 1979--orbiting over Saudi Arabia and later on Kamchatka, on the 10,169th and 10,172d orbits, the studies of the Porthole, Dawn and Contrast series were conducted....This marked the start of the Bulgarian scientific program.

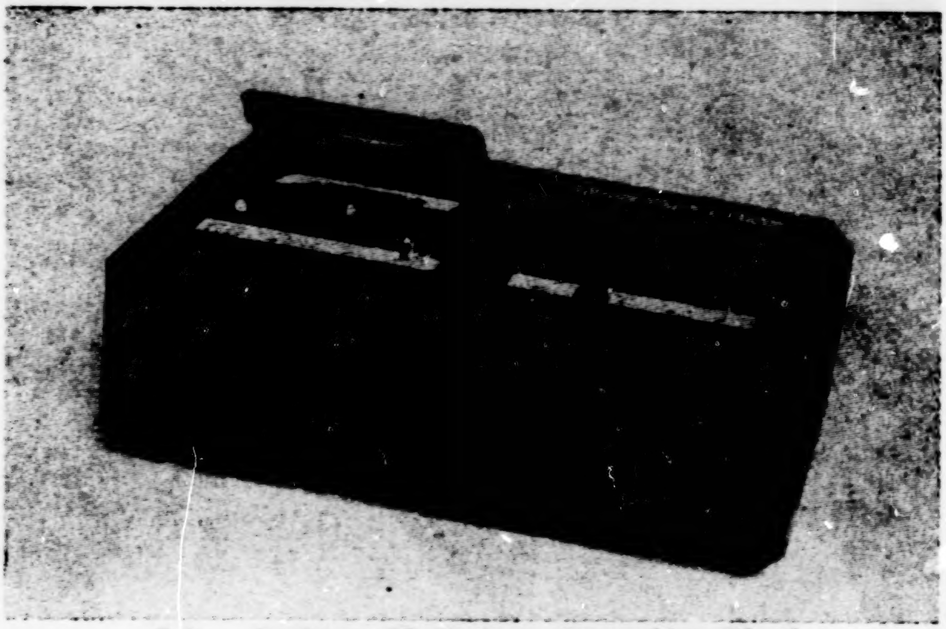


Spektur 15 Multichannel Spectrometric System
1.a. Spektur 15 K Optical-Electronic Block

These studies were continued later by the international crews involving the participation of cosmonauts from Hungary, Vietnam, Cuba, Mongolia and the USSR. I had the opportunity to work directly with all crews both before and after their flights. The importance of the studies and the great potential of Spektur 15 were frequently noted in the course of the preparations for the implementation of the scientific program in telemetric methods and work with the system. At the same time, we acquired the cassettes with recorded data returned by the crews, which were processed initially in Bulgaria at the TsLKI and subsequently by international scientific groups.

The decision of the Soviet governmental commission to adopt as regular (permanent) equipment the Spektur 15 multichannel spectrometric system for the subsequent

Salyut-type satellites was a high acknowledgment of Bulgarian science and technology. The recommendations of the several cosmonauts who had used Spektur 15 in space work were taken into consideration in the development of the next system. Let us mention above all V. Ryumin, V. Dzhanibakov, Yu. Romanenko, V. Lyakhov, B. Sarkas, N. Rukavishnikov and others. For example, it was cosmonaut V. Ryumin who suggested that light indicators be installed showing fitness for work, recording, overloading of the light flow and others within the range of the optical sight of Spektur 15 (which was introduced in Spektur 15 M) in the course of a meeting at the Yu. A. Gagarin Cosmonaut Training Center, immediately following his first 174-day space flight.



2.b. Spektur 15 KR Data Recording Block

The updated model of the Spektur 15 M multichannel spectrometric system, which will be installed on the next Salyut orbital station, was completed and accepted by the Soviet acceptance commission in July 1980.

An airplane variant of the Spektur 15 S multichannel spectrometric system was developed and tested under actual flight conditions in 1979-1980. It will be used in quasisynchronic studies and in the flight of the B-1300-II complex.

More than 50 tests were made with the Spektur 15 prior to the flight of the crews involving Mongolian and Romanian cosmonauts, synchronized with the Spektur 15 basic systems and apparatus, the MKF-6M and KATE-140. As K. Blagov, flight deputy manager, wrote in PRAVDA in April 1981, "...thousands of pictures were obtained with the KATE-140 Soviet printing instrument, thousands of multizonal pictures were made with the MKF-6M camera, developed by Soviet and GDR scientists, and several tens of thousands of spectrograms of natural formations were obtained with the Bulgarian Spektur 15 system...." The Spektur 15 system was extensively applied in resolving problems of agriculture. On 19 April 1981 TASS reported from Moscow that "more than 14,000 photographs and 100,000 spectral analyses of the earth's surface were made from the Salyut-6 orbital station for agricultural purposes (with the Spektur 15 system--author's note)...."

Spektur 15 was highly rated by the periodical NATURE, Vol 289, of 29 January 1981, and at the 1979 congress of the International Astronomy Federation, held in Munich, FRG, in the minutes of the working group on the telemetric study of earth from outer space.

In fact, as V. Kubasov, the famous Soviet cosmonaut, said at the 1980 congress of the international astronomy federation, held in Tokyo, "...the Spektur 15 system is not only unique but universal (for purposes of telemetric studies of earth from outer space--author's note)...."

The experience gained in the designing and use of the Spektur 15 system, which is a worthy representative of the great possibilities of Bulgarian science and technology, proved to be very useful in designing and building the scientific equipment for the B-1300-II project, particularly in the case of the SMP-32 multichannel spectrometric system, which enables us to record radiation in 32 channels of the visible and close infrared range.

In specific terms, the results obtained in the interpretation of data from measurements with the help of the Spektur 15 multichannel spectrometric system will be considered in a subsequent article in this periodical. However, we can note as of now that many new and interesting facts and results, which have found an application in science, technology and the national economy, have been obtained. The system is protected with several authorship invention certificates. New methods, technologies and systems have been developed as well. Perhaps the most accurate description of the system was provided by cosmonaut N. Rukavishnikov: "Spektur 15 is the latest all-seeing eye of the cosmonauts flying the Salyut-Soyuz complex." Here is what Bulgarian cosmonaut Col Engineer G. Ivanov said about the system:

[The following appears in the actual handwriting of G. Ivanov in the original text].

The Bulgarian Spektur 15 system was used in the course of 2 years of flights of the orbital Salyut-6-Soyuz-Progres scientific complex by members of six fraternal socialist countries! Could there be a greater recognition of Bulgarian scientific thinking and technology!

5003
CSO: 2202/7

REPORT ON NEW TECHNOLOGIES

Sofia SPISANIE NA BULGARSKATA AKADEMIYA NO NAUKITE in Bulgarian No 3, 1981 pp 92-96

[Text] Method for Obtaining Steroid Hormones with a Pregnane Skeleton

The method is protected as an invention with registration No 45,363, 24 August 1979. It was developed at the Bulgarian Academy of Sciences Institute of Organic Chemistry with Phyto Chemical Center, by a group of authors headed by Senior Scientific Associate R. Vlakhov.

This invention resolves the problem of the production of steroid hormones, such as hydrocortisone, prednisolone, 6-methyl-prednisolone, and other compounds with a pregnane skeleton, which are valuable pharmaceutical preparations. The method is part of a Bulgarian progam, aimed at making extensive use of available raw materials for synthesizing steriod hormones. Currently, the main sources for the synthesizing of such pharmacological products are diosgenine, which is extracted from a cactus, and sterine, extracted from wasteproducts of the cellulose industry. The method is related to the production of Reichstein Substance from 17a hydroxyprogesterone, which could be obtained from either of these two raw materials.

This method makes it possible to obtain steroid hormones more effectively and profitably and with a lesser number of technological operations. On the basis of a raw material available in our country, based on the invention Reichstein Substance, free or with protected functional groups, from various basic compounds, through microbial hydroxylation, valuable pharmaceuticals in great demand may be produced such as hydrocortisone, prednisolone, and others, which are currently not produced by our pharmaceutical industry for lack of suitable technology and raw materials. Furthermore, our method allows for the production of substantial quantities in the individual stages of the synthesis of steroid hormones, as a result of which a number of reactions can take place within a single reactor without isolating the product from the subsequent stages. For the first time, this method makes it possible to protect on an industrial scale the carbonyle group in the third position of the steroic molecule in the form of a perchloroeamine salt.

This invention is being developed at the Chemical-Pharmaceutical Plant in St. Dimitrov and may be used as the basis for cooperation with pharmaceutical companies in industrially developed countries. A patent request has been filed by the Bulgarial Academy of Sciences in the USSR, the GDR, Poland, Hungary, Czechoslovokia, Romania, Yugoslavia, Greece, Cuba, Brazil, Argentina, Japan, India, Malaysia, Thailand and Singapore.

Method for Surface Modification of Synthetic Artificial and Natural Polymer and Polymer Compositions with Metals, Metalloids and Gases through Ion Implantation at Low Energy

The method is protected with three invention registrations (No 47,001, 13 March 1980, 47,765 of 14 May 1980 and 47,766 of 14 May 1980), with patent requests filed in the U.S., Great Britain, the FRG, Japan, Canada, France, Swedan, Switzerland, Italy, the USSR, Czechoslovokia, and the GDR with a view toward subsequent licensing. It was developed by the Bulgarian Academy of Sciences Institute of Nuclear Research and Nuclear Power Industry by K. Kolev, A. Dzhakov, R. Yankov, B. Amov and L. Peeva.

No data exist so far on the application of the method of Ion Implantation for the modification of surface properties of polymers (plastics, and artificial fabrics in particular). In this respect, our method, which is suggested for the first time, is a major step in the involvement of materials with qualitatively new characteristics. Polymer material modified through the implantation of metals, metalloids, and gases are characterized by the following most general properties:

The implanted element, part of which has permeated under the polymer surface, is firmly fastened to the polymer material and forms a stratum which does not crack or separate under mechanical influence (friction, bending, crumbling, twisting, washing, etc.);

Polymer materials modified on the surface through the implantation of metals and metalloids show a lowered surface electrical resistance, which can be reduced evenly within a broad range;

Such materials have a higher level of heat and light reflection;

They can be used as a substratum on which metals and metalloid lining can be applied with the help of any currently known process.

The main advantage of this method for metalizing plastics is that the preliminary treatment of the surface to be metalized becomes entirely unnecessary (the same applies to metalloids and gases), as is the need for the use of various lacquers and coatings as fixatives for the metal stratum. A small quantity (a few grams in metalizing dozens of square meters of area) of inexpensive salts, which must be industrially (and not also analytically) pure, are the starting product for the ionizing of the necessary metal (metalloid) in the ion source.

The practical application of this method is very promising. It could be successfully used in the chemical industry, medicine, agriculture, light industry, astronautics, consumer items, etc.

The method is currently under development at the Institute of Nuclear Research and Nuclear Power Industry, where a system for the manufacturing of prototypes has been created.

General Sowing Control System

The system is based on three inventions (Registration Nos 47,754, 47,755 and 47,756, dated 14 May 1980) at the Technical Cybernetics and Robotics Institute of the Bulgarian Academy of Sciences by a group of authors headed by Scientific Associate K. Boyadzhiev.

The system provides an objective basis for assessing the work of the plowshare of grain crop seeding machines, the rotation of the seeding shaft and the level of the grain in the hopper. It can control as many as eight sowing machines simultaneously using as many as 24 plowshares each. For this reason it is based on the modular principle: it consists of two main blocks and optical electronic meters. The control block is mounted on the tractor. The number of the improperly working machine and information on irregularly rotating shafts or inadmissibly low levels of seed in the hopper are indicated through sound signals and flashing lights. The control system is installed on each sowing machine. Digital light flashes indicate consecutively and cyclically the number of the irregularly functioning plowshare. The system provides extensive and easily accessible data without any additional handling on the part of the servicing personnel. It can be applied in checking grain crop seeding machines (joint sowing) of the SZ-3.6; CZU-3.6 and SZA-3.6 models, which are standard machines used in Bulgaria and the USSR, as well as machines with sowing plowshares of the same models.

The use of this totally automated system improves the regularity of the sowing, which yields greater economic results. Regular production of the system was undertaken at the Plant for Electronic Nonstandard Equipment in Tolbukhin in 1981.

Method for the Production of Glucosoisomerase

The method is protected by three invention registrations (Nos 45,720 and 45,721 of 29 November 1979 and No 49,423 of 21 October 1980), with patent applications filed in the United States, Japan, Canada, Mexico, the FRG, The Netherlands, Denmark, France, Italy, Great Britain, Belgium, Spain, Switzerland, Austria, Finland, the USSR, the GDR, Romania, Hungary and Yugoslavia, with a view to license sales and eventual protection of exported items. The inventions were developed at the Bulgarian Academy of Sciences Institute of Microbiology by a group of authors headed by Senior Scientific Associate Dr M. Stoychev and coauthors Scientific Associate Engineer G. Dzhezheva, I. Todorov and N. Stoeva.

Invention No 45,720 deals with a method for obtaining glucosoisomerase with strain streptomyces sp. No 765. This enzyme converts d-glucose into d-fructose, which is being increasingly used in the food industry and dietetic nutrition in a number of countries. The method has the following advantages: the strain produces the enzyme in the absence of cobalt ions in the fermentation environment and isomerizes the glucose into fructose also in the absence of cobalt ions, thus considerably simplifying the technological process and eliminating the use of ion-exchange systems for the separation of the cobalt from high-fructose syrups. The produced strain is superior to already-patented similar microorganisms and mutants because of its glucosoisomerase activity (from 7,000 to 12,000 GIE per liter of culture), favorable pH isomerization optimum (7.0), higher temperature optimum (80°C) and considerable thermal stability of the enzyme between 40°C and 70°C.

Invention registration No 45,721 applies to a method for obtaining glucosoisomerase from streptomyces sp. No 1339 strain. This enzyme converts d-glucose into d-fructose, whose syrups are being increasingly used in the food industry, public catering and dietetic nutrition in a number of developed countries. The advantages of the method are that the produced strain has the high biosynthetic possibilities of the enzyme (from 12,000 to 20,000 GIE per liter in a fermentation environment). The enzyme is characterized by its high temperature optimum (70°C) and requires low optimum concentrations of cobalt ions in the isomerization mixture. It has a favorable pH optimum (7.0) and a considerable thermal stability between 40°C and 65°C. The production of moist biomass ranges from 140 to 220 grams per liter in a fermentation environment.

Such enzymes can be produced by the Ministry of the Chemical Industry or the National Agroindustrial Union and can be used extensively by the food industry in the production of high-fructose syrups which are used by the sugar refining and canning industries, the production of nonalcoholic and alcoholic beverages, the confectionary industry, the baking industry, public catering, trade, dietetic foods, the feeding of bee colonies, and others.

Increasing Grape Production with Chlorocholinchloride (CCC) Treatment

A method and technology for the treatment of vineyards with a water solution of chlorocholinchloride (CCC) in the early spring, immediately before the blossoming of the buds, have been developed at the M. Popov Plant Physiology Institute of the Bulgarian Academy of Sciences, under the supervision of Prof Dr D. Lilov. This treatment temporarily reduces the intensity of the growth. As a result, higher amounts of nutritive substances reach the racemes, ensuring fuller fruit setting and an increased number of grapes and amends. The treatment can be highly effective only with well-cared-for and strong, rather than weak and sickly, vines. The making and spraying of the solution can be done manually or mechanically. The fruit twigs must be totally soaked, which requires about 60 liters per decare. Pesticides for use against diseases, pests and weeds may be added to the solution.

CCC has no adverse effect on the fruitfulness of the vines the following year. The 3-year industrial testing and model use of the technology have increased yields from 10 to 54 percent without worsening the quality of the grapes.

No such method for CCC treatment is known to exist currently in domestic and world science and practical experience. Savings from this method average 18 leva per decare. The Ministry of Public Health has allowed the use of this preparation in viticulture. Industrial tests and model application practices were conducted at the agroindustrial complex and the LVK (Viticulture and Wine-Making Combine) within the National Agroindustrial Union system.

Opening of a Central People's Park in Stara Planina

The Scientific Coordination Center for Environmental Protection and Reproduction (NKTsVOS) of the Bulgarian Academy of Sciences, headed by specialist Zh. A. Spiridonov, is working on the development of a large protected territory--a people's park--which will include the largest and most valuable reserves in Sredna Stara Planina: Tsarichina, Steneto, Stara Reka, Dzhendema, Peeshti Skali, Sokolna, etc. Typical mountain, high-mountain and rock habitats and ecological systems representing the biotic variety of the Stara Planina area to the greatest extent, will be largely ensured over an area in excess of 40 hectares. Not only primary ecosystems of widespread and economically important forests (beech, for example), but coniferous, deciduous and mixed forests will be protected in the people's park and its reserves. Populations of hundreds of vegetal and animal species included in the "Red Book of Rare or Endangered Species in the Bulgarian People's Republic" will be protected in the park.

Runoff Control

Mathematical models, algorithms, block systems and computer programs have been developed and applied at the Bulgarian Academy of Sciences Institutes of Water Problems, under the direction Senior Scientific Associate N. K. Nikolova, for runoff control purposes. The Monto Carlo method was used for a basin of comprehensive use by n number of water users, regardless of the water utilization complexity. With such models and computer programs the runoff and irrigation water consumption are considered as interdependent probability processes. The programs yield the three possible curves of availability: siphoned-off water, the filling of the basin and the spilled quantities, on the basis of which optimum control parameters can be defined: the computed guaranteed water consumption, level of runoff control and basic capacity.

On the basis of the computed water shortages in the nonsecured season, the optimum support of irrigation, water supply and hydraulic power can be computed.

5003
CSO: 2202/7

FURTHER REPORT ON NEW TECHNOLOGIES

Sofia SPISANIE NA BULGARSKATA AKADEMIYA NA NAUKITE in Bulgarian No 4, 1981 pp 77-80

[Text] Technology for Acid Brilliant Copper Lining and Complex Additions BS-1 and BS-2

The technology and the two supplements are based on four inventions (registration Nos 45,052 and 47,849 of 5 Oct 1979 and 45,879 and 45,880 of 10 Dec 1979), developed by Institute of Organic Chemistry and Institute of Physical Chemistry by a group of authors headed by Senior Scientific Associate I. Pozharliv and Senior Scientific Associate St. Rashkov. Together with the Institute of Chemistry and Chemical Technology of the Lithuanian SSR Academy of Sciences, a joint authorship certificate was registered in the USSR under No 2,973,802/02.

Patent applications for the main invention have been filed in the United States, Great Britain, the FRG, France, Italy, Brazil and Turkey.

The new additions and the technologies represent an advanced variant of the familiar additive for acid brilliant copper lining B-7211. They ensure a higher evening ability in the copper lining of complex-shaped parts eliminating dendrites and carbon deposits with high speed lining. They are superior to similiar technologies developed by foreign companies in terms of basic technical and economic indicators.

Such lining, based on our inventions, is used as the precoat in the chromium-nickel lining of steel items, zinc castings and metalizing of plastics. The automotive, household and sanitation industries are the main consumers for such additions. In cases where higher quality protective and decorative coating is required, the BS-1 and BS-2 technology and additions will be applied in the galvanizing shops of the enterprises of the Ministry of Machine Building and Electronics and elsewhere, as well as in automotive plants in the USSR and other socialist countries.

Industrial tests were conducted at the VAZ in Toliati, USSR. A sample industrial batch of additives was produced at the Chemical Plant in Kostenets. Exports of this item are expected to yield considerable foreign currency.

Khromopor Complex Additive and Technology for the Precipitation of Microporous Nickel-Chromium Lining

A technology has been developed for the precipitation of microporous nickel-chromium coating with a view to improving the corrosionproof qualities of the copper-nickel chromium multiple-layer system. The development is protected with three invention registrations (No 24,149/1975, No 24,886/11 Oct 1977 and No 48,779/7 Aug 1980), developed by a group of authors at the Bulgarian Academy of Sciences, Institute of Physical Chemistry and the D. Blagoev VINS [Higher Institute of the National Economy] in Varna, headed by Senior Scientific Associate St. Rashkov.

The microporous condition in the chromium coating is created by the precipitation of a nickel precoat with built-in nonconductor particles (the Khromopor Additive). The complex Khromopor Additive is superior to other such additives in terms of sedimentation durability. The increased corrosionproof ability of the multiple layer system makes it possible to reduce the thickness of the nickel stratum by about 30 percent.

The technology for the electrolytic precipitation of microporous nickel-chromium lining will be used in the lining of steel parts operating under demanding and very demanding operational conditions. Following the completion of successful semi-industrial tests at the Moskvich AZLK in the USSR, the plant undertook the industrial testing of the technology. The regular production of the Khromopor Complex Additive will be undertaken at the Chemicals Plant in G. Oryakhovitsa before the end of 1981.

Additive and Technology for Brilliant Nickel-Iron Alloy Lining

Invention No 39,401/13 Apr 1978, was made at the Institute of Physical Chemistry and patent applications were submitted in the United States, Great Britain, Japan, France, Italy, Yugoslavia, the USSR, the GDR, Czechoslovakia, Hungary, and Romania with a view to protecting this exportable commodity and creating conditions for the sale of licenses. The invention is the work of St. Vitkova, V. Mircheva, M. Kuncheva, G. Raychevski, St. Armyanov, Iv. Todorov, St. Rashkov, and M. Chomakova.

The main purpose of this development is to replace most of the brilliant galvanized nickel coats with brilliant nickel-iron lining (up to 30 percent iron) which is of equal functional quality. The advantage of this development is the considerable saving of nickel, which price on the international market is rising steadily and which our country imports. There are technical advantages in the use of this technology in galvanizing shops: The iron ions, which inevitably pollute the nickel lining electrolytes, do not have to be precipitated; the alloy offers a better base for the chromium lining in the sense that the lining ability of chromium electrolytes is better when deposited on nickel-iron compared to nickel; the nickel-iron lining has a higher degree of plasticity compared to nickel. The used electrolyte is almost half as dense as the nickel lining electrolytes, which requires a lower investment in the initial charging of the tubs, shorter electrolyte cleaning and treating time, and the easier and less reacting treatment of waste water.

The invention may be applied in protective-decorative lining in jewelry, electronics, furniture and household equipment, medical instruments, sports equipment, parts of bicycles, motorcycles and cars, etc. This development is in the process of application. The regular production of this brilliant additive has been organized and currently industrial tests are taking place in several galvanizing shops in the country.

Method for Obtaining Fine Protective-Decorative Nickel-Copper-Nickel Lining

The method is protected by invention registration No 46,543/8 Feb 1980. It was developed at the Bulgarian Academy of Sciences Institute of Physical Chemistry in coauthorship with specialists at Orgtekhnika in Silistra; Senior Scientific Associate St. Rashkov headed the group of authors.

A technology has been developed for the electrolytic coating of fine (5-12 microns) nickel-copper-nickel lining of steel parts. The procedure includes the preliminary preparation of the parts, the basic galvanizing processes with respective intermediate operations and the final process. This lining is shiny and smooth, perfectly clinging to the foundation and between the individual strata and has very good corrosionproof qualities. Modern highly productive electrolytes free from toxic chemicals are used for the production of the individual strata.

The technology was developed to meet the growing need for fine protective-decorative lining consistent with the strict requirements of computer equipment, electronics and electrical engineering. However, it can be used also for thick nickel-copper-nickel lining in machine building.

The technology is regularly used in industry and has been applied successfully at the Orgtakhnika Plant in Silistra as of Dec 1979 and at the Construction Elements Plant in Blagoevgrad since Jan 1980.

Structure and Technology for Colorless and Color Chromatizing (Passivation) of Shining Zinc Galvanized Lining

This development is protected with two invention registrations (No 44,462 and 44,463 of 26 July 1979). It was developed at the Institute of Physical Chemistry by the following authors: Scientific Associate V. Velinov, Scientific Associate D. Stoychev, Scientific Associate Iv. Krustev, Engineer I. Vitanova, Scientific Associate M. Nikolova, Senior Scientific Associate St. Rashkov, Chief Assistant G. Velinov and Chief Assistant L. Tsalev.

The technology may be used for colorless and color chromatizing. It is used for passivating shining Zinc lining with a view to upgrading resistance to corrosion. A major advantage of the passivation solutions is their very low content of chromium ions (from 0.16 to 0.22 g/l for colorless and 20 g/l for color passivation), which is substantially lower compared with other technologies. This saves chromium and facilitates the treatment of wastewater, therefore, it yields economic and social results. The passive conversion films provide very good resistance to corrosion, good adhesion to the base, resistance to washing and bending, good external appearance, etc. The quality of the passivated lining is as good as the results of the best worldwide technologies.

The development is used at the Sukhe Bator APK (Agroindustrial Complex) in Srednogorie and the Maritsa Typewriter Manufacturing Plant in Plovdiv. It will be applied in a number of galvanizing shops for zinc lining and at enterprises of the Ministry of Machine Building and Electronics, Ministry of Light Industry, etc. These compositions are already under production at the Chemicals Plant in G. Oryakhovitsa under the trade marks of Duga for color passivation, and BP for colorless passivation and are being sold to consumer plants.

Electrolyte for Alkaline Noncyanide Zinc Plating "Ekolal-80"

This development includes the invention "Electrolyte for Alkaline Noncyanide Zinc Plating," registration No 48,520/17 July 1980, developed by the Bulgarian Academy of Sciences Unified Chemistry Center by the following authors: Scientific Associate V. Balutsov, Scientific Associate V. Velinov, Senior Scientific Associate I. Bozharliev, Senior Scientific Associate St. Rashkov, Professor I. Mladenov, Scientific Associate V. Mircheva, Scientific Associate M. Nikolova and Scientific Associate I. Krustev.

The technology for galvanic zinc plating was developed on the basis of a new type of alkaline noncyanide electrolyte, with a high dispersion ability, which makes possible the coating of corrosion-proof, evenly shining coating in a wide range of current densities. The main purpose of the technology is to replace the existing cyanic electrolytes for zinc plating, thus eliminating the threat to health from production servicing and the subsequent polluting of the environment with strongly toxic cyanic compounds. It also ensures the high quality of the lining and lowers production expenditures for the treatment of wastewaters.

The development is applied at the Maritsa Typewriters Plant in Plovdiv and the Radio Plant in Samokov. This electrolyte will be applied extensively at the galvanizing shops of the enterprises of the Ministry of Machine Building and Electronics and elsewhere for the preservation of steel parts from corrosion.

The regular production of unlimited quantities of this additive for electrolytes is being organized at the Chemicals Plant in G. Oryakhovitsa.

5003
CSO: 2202/7

COOPERATION IN JOINT INSTITUTE OF NUCLEAR RESEARCH DESCRIBED

Prague POKROKY MATEMATIKY, FYZIKY A ASTRONOMIE in Czech No 5, 1981 pp 261-276

[Article by Frantisek Becvar, Pavel Exner, Miroslav Finger, Marian Gmitro, Richard Lednicky, Jaroslav Sedlak and Ivo Zvara, Dubna: "Twenty-Five Years of the Joint Institute of Nuclear Research"]

[Text] The writing of a new, significant chapter in the history of a number of branches of physics, mathematics, chemistry and engineering has been proceeding for the last quarter-century in Dubna, a modern, picturesque town on the banks of the Volga about 130 km north of Moscow. The Joint Institute of Nuclear Research [SUJV], an international scientific center for cooperation among the socialist countries in nuclear physics and associated fields, was founded here in 1956. Its principal mission is to find an answer to the simplest and at the same time most difficult questions to which man has fallen heir: the nature of matter, space and time. The institute's 25-year existence has convincingly shown what a fortunate undertaking this has been: for the institute has proven to be a particularly effective organization which is also having a pronounced influence on the overall quality of physical research, particularly in the smaller member countries.

The work of the SUJV has made an unquestioned contribution to the development of a number of areas of physics in Czechoslovakia, and all of the organizations involved have a high opinion of it. We take the opportunity of this year's significant anniversary to provide a survey of the purposes, organization and scientific work of the SUJV and of Czechoslovakia's participation in its research, prepared by members of our national group at Dubna.

We also take the opportunity to wish the SUJV new, important successes in its next 25 years and a continuation of the youthful, creative spirit which is so characteristic of it.

The Joint Institute of Nuclear Research

This institute is the oldest and still the largest international research center of the socialist countries. Currently, scientists from Bulgaria, Hungary, Vietnam, East Germany, North Korea, Cuba, Mongolia, Poland, Romania, the Soviet Union and Czechoslovakia work in it. The institute is engaged in research on the physics of elementary particles, nuclear and neutron physics, the physics of condensed systems, nuclear chemistry and the development of accelerators. Including the administrative departments, more than 6,000 persons are employed at the institute. Most of them are from the host country, while about 600 specialists have been sent to Dubna on long-term assignment by the other member countries; the majority are scientists and engineers.

The agreement to establish the SUJV was signed in Moscow on 26 March 1956 by plenipotentiary representatives of the member governments. The institute's charter, governing all of its activities, was adopted at the ensuing first session of the Assembly of Plenipotentiary Representatives on 23 September 1956.

The purpose and tasks of the SUJV can be briefly summarized as follows: joint experimental and theoretical research in nuclear physics (including all of the fields mentioned above), support for the development of nuclear physics in the member countries, support for contacts with national and international scientific research and other organizations in the field for the purpose of developing nuclear physics and identifying and making use of new possibilities for the peaceful use of atomic energy, and cooperation in comprehensive development of the creative capabilities of scientific research personnel from the member countries.

According to the agreement, the operation and development of the institute are funded by the member countries. The size of each member's contribution depends on its economic capabilities and national income. Currently, for example, the Soviet Union meets about 75 percent of the institute's budget, while Czechoslovakia's contribution is slightly more than 4 percent. According to the charter, however, the size of a member country's contribution does not affect its participation in the scientific work and management of the institute.

The highest management organ of the institute is the Assembly of Plenipotentiary Representatives of the member governments; the representative of the Czechoslovak Government is CSAV [Czechoslovak Academy of Sciences] Chairman Academician J. Kozesnik.* The committee meets annually and decides on such basic matters as the budget, the capital construction plan, long-term, five-year and annual scientific research plans, the size of the member countries' contributions, the acceptance of countries as new members and the like. The financial work of the institute is controlled by a committee in which each member country has one vote.

The management of the institute is chosen by the Assembly of Plenipotentiary Representatives and is responsible to the latter for all of the institute's activities: scientific, financial and administrative.

A scientific council, which meets twice a year, makes decisions on the institute's scientific activity. According to the charter, each member country is represented on the council by three leading specialists. The council discusses and approves plans for scientific research and international contacts, research reports, and awards prizes for the best work. The scientific council submits its proposals regarding scientific planning, financing, the construction of new facilities and the like to the Assembly of Plenipotentiary Representatives.

---

* (Ed. note: The draft of this article was written in 1980).

Within the institute, there are a number of consultative and cooperative bodies created by special agreements; these include the scientific councils for high-energy, low-energy and theoretical physics, which are sections of the institute's scientific council. Special committees operate within these sections, and scientific and technical councils and scientific certification councils function in the institute's laboratories.

The organizational structure of the institute follows from the general principles laid down in the charter. The institute has six laboratories. The four experimental laboratories, namely, the Laboratory of High Energies, the Laboratory of Nuclear Problems, the Laboratory of Nuclear Reactions and the Laboratory of Neutron Physics, which by their size are in fact large research institutes, work with unique basic equipment: proton accelerators, synchrophasotrons and synchrocyclotrons, cyclotrons for accelerating heavy ions, pulsed nuclear reactors and the like. Two other laboratories, the Laboratory of Theoretical Physics and the Laboratory of Data Processing and Automation, have an important role; none of the other laboratories could operate without their services. The institute also has a department of new acceleration methods, which is in fact a seventh laboratory. Each laboratory is divided into departments, which are in turn divided into sectors; each sector is generally assigned one research task. The management of the SUJV decides on the basic financial questions involved in the laboratories' work; directly subordinate to it are the administrative and production sections and several specialized departments such as the department of international contacts, the scientific secretariat, the publications and patents department and the like.

The highest management posts in the SUJV, namely, the positions of director and (two) deputy directors of the institute and directors and deputy directors of the laboratories are filled by election from among the representatives of the member countries. Traditionally a Soviet physicist is chosen director of the institute. Between the founding of the institute and 1964, a Corresponding Member of the USSR Academy of Sciences, D. I. Blokhintsev, recently deceased, held this post. Since then the director has been Academician N. N. Bogolyubov, who is world-renowned for his work in theoretical physics. Representatives of almost all of the member countries have alternated in 3-year terms as deputy directors; physicists from our country have been deputies three times.

Czechoslovakia's Participation in the SUJV

Our republic is one of the founding members of the SUJV and since its founding has also been one of the countries most actively participating in the scientific research program. This is also reflected in the institute's leadership posts. Representatives of our country have been chosen deputy directors of the institute three times: Academician V. Votruba in 1956-1969, Prof I. Ulehla in 1964-1967, and Prof C. Simane in 1973-1976. Many of our personnel have also held leading positions in the various laboratories. Currently, for example, Czechoslovak physicists are acting as deputy directors of the Laboratory of Nuclear Problems and the Laboratory of Neutron Physics.

The Czechoslovak national group is traditionally one of the largest in Dubna; currently only the groups from East Germany and Poland are somewhat larger. Czechoslovakia is now represented in the institute by about 65 persons sent there on long-term assignment, generally for several years, by their parent organizations in a number of ministries (CSAV, MS [Ministry of Education], CSKAE [Chechoslovak Atomic Energy Commission] and the like). They include 1 doctor and 30 candidates of science. In addition, every year about 200 of our specialists visit Dubna for brief periods of from several weeks to several months. These visits generally involve the solution of specific problems. Also working in the institute are a number of spouses of Czechoslovak representatives; the institute employs a total of about 90 of our citizens. Staff members on long-term assignment are generally accompanied by their families. On the average, about 150-180 Czechs and Slovaks live here.

Each of the laboratories has its own indispensable role in the structure of the institute, and naturally our participation varies from laboratory to laboratory. Traditionally we are most strongly represented in the Laboratory of Nuclear Problems and the Laboratory of Theoretical Physics (a simple comparison of numbers of personnel cannot be made; the number of theoreticians among those engaged in physical research must be taken into account). At the end of this quarter-century we may express justifiable pride in our staff members' participation in the contribution which these two laboratories have made to worldwide science. In addition, Czechoslovakia is strongly represented in the Laboratory of High Energies and the Laboratory of Neutron Physics, and the results achieved by our personnel have earned no less recognition there. Staff members from our country have also taken part in important successes of other laboratories in the institute, even though our country is much less strongly represented in them. A more detailed survey of our specialists' work in the SUJV is given in the sections dealing with the individual laboratories below. An important form of cooperation between Czechoslovak institutes and the SUJV is the processing in Czechoslovak organizations of experimental data obtained at the institute, often as part of international cooperation.

A concrete expression of the value placed on the scientific results achieved by the members of the institute is the prizes which are awarded annually for the best work in theoretical, experimental and applied physics, as well as high-level, state and other prizes. At the end of this survey we list the SUJV prizes which have been awarded to collectives in which Czechoslovakia has participated. Another criterion is the number of scientific degrees awarded. During the institute's existence, dozens of Czechoslovak specialists have defended candidate's dissertations here, and two have defended doctoral dissertations.

The Laboratory of High Energies

This laborotory is the largest in the institute and is one of two which were presented to the institute by the Soviet government when the SUJV was founded in 1956. Currently more than 1,000 persons work in the laboratory, including 16 doctors and about 80 candidates of sciences. The laboratory director is A. M. Baldin, Corresponding Member of the USSR Academy of Sciences.

The main experimental installation of the laboratory is a synchrophasotron which accelerates protons to 10 GeV with an intensity of 10^{12} protons per pulse (about one every 9 seconds), which became operational in 1959. Since 1979 it has also been used to accelerate light nuclei, enabling the laboratory's physicists to begin research in the previously unexplored field of relativistic nuclear physics.

The laboratory develops and systematically improves new experimental equipment, in addition to which it makes extensive use of promising methods of particle detection and the latest achievements of radioelectronics and data processing. International cooperation is particularly important in this laboratory. The equipment developed here is being used not only with the institute's accelerator beams, but also in the accelerators of the Institute of High-Energy Physics in Serpukhov, in CERN [European Organization for Nuclear Research] in Geneva, and in the Fermi National Accelerator Laboratory (FNAL) in Batavia, United States. These include the NA-4, BIS, ALFA, DISK and FOTON spectrometers, consisting of drift, spark and proportional chambers, as well as Cerenkov counters with on-line computers, large streamer and bubble chambers such as the SKM-200 and LUDMILA, and other unique devices.

The Laboratory of High Energies has also developed and produced modern electronic equipment for physical experiments, such as a wide selection of assemblies and recording electronics using integrated modules of the CAMAC system. Cryogenic techniques are also being successfully developed. Several hydrogen bubble chambers and a large number of targets filled with liquid hydrogen and deuterium have been produced. To investigate elastic scattering of protons by protons, deuterons and nuclei using the proton beam from the accelerator, an original-design target in the form of a stream of gas was developed; after the conclusion of experiments at Dubna these were also put into use in Serpukhov and Batavia. An important place in the laboratory's development is occupied by work on the NUKLOTRON project, an accelerator complex for relativistic nuclei which uses superconducting magnets.

The main areas of physics research in the Laboratory of High Energies include investigation of the structures of elementary particles and their interactions, resonance states and the dynamics of multiple-particle production, and the study of weak interactions and the interactions of nuclei at relativistic energies. Among the results in which physicists at the laboratory lead the world we may mention the discovery of the anti-sigma-minus hyperon, measurement of the electromagnetic radius of negatively charged pions, and the discovery of channeling of protons in a flexed crystal.

At present, Czechoslovakia is represented in the Laboratory of High Energies by 12 workers sent to Dubna on long-term assignments by 7 Czechoslovak organizations, working in various departments of the laboratory, as described below.

1. In the experimental hydrogen chamber department, studying the interaction of antiprotons and antideuterons with protons and deuterons using the 2-meter LUDMILA hydrogen chamber located in a channel of separated particles from the Serpukhov accelerator. This work is being carried on with extensive international cooperation involving about forty physicists from 11 institutes in Bulgaria, Czechoslovakia, Finland, Romania and the Soviet Union. Our organizations include the Institute of Physics, CSAV, the Nuclear Center of MFF UK [Department of Mathematics and Physics, Charles University], and the Department of Nuclear Physics of UPJS [Pavel Jozef Safarik University]. Czechoslovak physicists have an exceptional position in these experiments owing to their contribution to the design of the LUDMILA chamber and their development of the initial proposal for the program of physics experiments using the chamber.

2. In the experimental chamber department, studying interactions of protons with the nuclei of a photographic emulsion. Some 35 physicists from 11 institutes in Czechoslovakia, Mongolia, Romania and the Soviet Union are working on this task, including representatives of UPJS in Kosice and the Institute of Nuclear Physics in Rez. In addition, work is being done to develop new types of trace detectors from silver halide monocrystals.

3. In the experimental electronics department, studying highly inelastic interactions of muons with nuclei. This experiment, designated NA-4, is intended to study the structure of nucleons at very short range and to test the theory of weak and electromagnetic interactions. The equipment is installed on the proton supersynchrotron at CERN. A number of personnel from the SUJV member countries and CERN member countries are working on this task, including personnel from the Institute of Physics, CSAV and the Nuclear Center, MFF UK, as well as physicists from Sacalay, Munich and Bologna, totaling about 150 persons.

4. In the new scientific projects department, designing a measuring system for monitoring superconducting magnets. The Institute of Physics, Slovak Academy of Sciences is working on this task.

5. In the cryogenics department, working on the superconducting accelerator NUKLOTRON and UNK projects. Personnel from the Institute of Electrical Engineering, Slovak Academy of Sciences, have developed diagnostic methods for testing the pulsed superconducting magnets. In addition, the Skoda National Enterprise in Plzen and the FEROX National Enterprise in Decin are working on a short-term problem, the development and production of superconducting quadrupoles to guide beams of accelerated particles in the laboratory's synchrophasotron.

Czechoslovak personnel on short-term assignments to Duba are cooperating on a number of other topics being dealt with by the laboratory. These include the search for new resonances using the DISK-2 spectrometer (FZU [expansion unknown], CSAV, the study of the interactions of alpha particles with protons in a 1-meter hydrogen chamber (UPJS Kosice), experiments with a 2-meter propane chamber (Department of Nuclear Physics, MFF UK) and the like.

The Laboratory of Nuclear Problems

This is the oldest laboratory in Dubna and one of two which were formed on the basis of the Joint Institute in 1956. Currently it has more than 800 personnel, including 19 doctors and about 100 candidates of science. The director of the laboratory is V. P. Dzhelepov, Corresponding Member of the USSR Academy of Sciences.

The main experimental installation in the laboratory is the synchrocyclotron, which is currently being reconstructed. After the reconstruction is completed in 1981 it will provide a beam of protons with an energy of 700 MeV and an intensity of about 50 microamperes, i.e.. about 21 times higher than previously.

The range of scientific problems studied by the Laboratory of Nuclear Problems is quite extensive and includes the solution of fundamental problems of nuclear physics and the physics of elementary particles, and also the solution of specific problems of physics of the condensed state, meson chemistry, dosimetry, and radiation protection. In addition it studies the effect of various types of radiation on biological specimens, and an important part of the laboratory's program is occupied by accelerator physics and engineering and low-temperature engineering.

The reconstructed synchrocyclotron will make it possible to carry on research in the laboratory's traditional areas of physics at a new experimental level. These areas include, in particular, nuclear spectroscopy, which in recent years has focused on the systematic study of neutron-deficient isotopes of the rare earths as part of the JASNAPP [expansion unknown] program. The laboratory's contribution is its work on the SPIN [expansion unknown] equipment, which is the task of Czechoslovak physicists and engineers. The aim of research work with this device is investigation of the decay of short-lived nuclei, using hyperfine interactions at very low temperatures, and the application of this technique to research in nuclear physics and the physics of condensed matter. The work involves extensive international cooperation in which about 50 physicists and engineers from many countries are involved. Czechoslovak organizations involved in the work include Charles University, CVUT [Czech Institute of Technology], FZU, CSAV in Prague, and UPT [Institute of Instrumental Engineering] in Brno.

For almost 20 years, the Laboratory of Nuclear Problems has been studying catalysis of the fusion of hydrogen isotope nuclei by muons. The resonance nature of fusion of deuterium and tritium nuclei was proposed theoretically and demonstrated experimentally. Calculations have shown that during its lifetime the muoni is capable of catalyzing more than 100 fusions of deuterium and tritium nuclei into helium, causing the liberation of about 2 GeV of energy. Experiments have confirmed the correctness of the theory. The study of these phenomena will constitute one of the most important areas of research with the reconstructed accelerator.

In the physics of elementary particles, the properties of strong interactions of nucleons and pions, electromagnetic processes, and weak interactions in processes involving pions and muons have been studied. Detailed study of nucleon-scattering led to the determination of their effective reaction cross sections at low energies. Investigation of the interactions between pions and nucleons produced data confirming with high precision the charge-independence of the nuclear forces and demonstrated the correctness of the principle of causality within experimentally attainable limits. In addition, polarization phenomena in elastic scattering of neutrons by protons have been studied using a polarized target at a neutron energy of 600 MeV. The new reconstructed accelerator will allow the study of low-probability phenomena such as rare pion and muon decays. In addition, an experimental facility for the study of the effect of protons and negatively charged pions on the cells of malignant tumors is being built.

In recent years, the laboratory has been stepping up its research in particle interactions at high energies using the accelerator of the Institute of High-Energy Physics at Protvino near Serpukhov. Primary interest is directed toward the quark-parton structure of hadrons and multiple production of secondary particles. In addition, experiments involving the study of polarization phenomena in the collisions of strongly interacting particles and studies of the production of neutral mesons and photons by relativistic beams of positronium are also being prepared. For this purpose, the laboratory is developing a detector system consisting of dozens of detectors of various types. The most important components of these are electronic devices (proportional and drift chambers, spark chambers, Cerenkov radiation detectors and the like), which can be connected directly to computers.

The laboratory has been designated the responsible organization for SUJV's scientific program at the Institute of High-Energy Physic's accelerator in Protvino, where 10 large detection devices prepared for experiments scheduled for 1981-1985 have been installed. The largest of these is the HYPERON spectrometric system, in whose construction personnel from UFF [? Physics Institute] SAV, PF [? Physics Faculty] UPJS in Kosice and PF UKo [? Physics Faculty, Komensky University] in Bratislava participated. The equipment will be used to study the interaction of positively charged particles with exchange of hypercharge and the production of two or more strange particles in the final state.

Another device built with Czechoslovak participation (FZU CSAV Prague) is a relativistic ionization spectrometer and streamer chamber (RISK) intended for the study of the quark-parton structures of elementary particles and the interactions of nucleons, mesons and protons with nucleons and heavy nuclei. Two of the experiments to be carried out with this equipment next year were designed in cooperation with FZU CSAV and PF UKo. Staff members of FZU are finishing the preparation of the apparatus for another experiment whose aim is to study the occurrence of the J/psi resonance accompanied by the production of other strongly interacting particles. This is expected to result in new data on the structure of hadrons and the mechanism of their interaction.

Thus the Laboratory of Nuclear Problems is the laboratory in which Czechoslovakia is most strongly represented: currently about 30 Czechoslovak personnel on long-term assignment work in it. In addition to the institutes and faculties mentioned above, these include physicists from the Department of Mathematics and Physics of Charles University in Prague and from several departments of CVUT (experiments of the SPIN device), and specialists from a number of other Czechoslovak organizations.

The Laboratory of Nuclear Reactions

This laboratory was founded in 1956 not long after the creation of the Joint Institute. Now it has more than 350 workers, including 7 doctors and about 50 candidates of science. The laboratory director is G. N. Flerov, Academician of the USSR Academy of Sciences.

The experimental base of the laboratory consists of three cyclotrons. The oldest of these is the U-300 classicial cyclotron with 3-meter magnet field pieces. The U-200 cyclotron, 2 meters in diameter, with azimuthal variation of the magnetic field, was built later; it is currently being used as the model for the newest device, the 4 meter U-400 cyclotron. All this equipment is designed for accelerating heavy ions (boron, carbon, oxygen and the like, through xenon in the case of the U-400), to which they impart an energy equivalent to about one-tenth the speed of light. This is sufficient to produce nuclear reactions with any target nuclei.

The U-300 cyclotron, which went into operation in 1960, was for many years the foremost in the world in terms of its characteristics (variety of particles and beam intensity). The construction of the U-400 cyclotron was a logical and inevitable step toward providing a modern experimental basis for future research on heavy ions by the SUJV member countries.

The main research task of the laboratory is study of the properties of new elements in the periodic table. Their synthesis results from fusion of accelerated nuclei with target nuclei of uranium and transuranium elements provided in a reactor (plutonium, curium, californium and the like). In the past, elements with atomic numbers from 102 to 107 have been discovered at Dubna, and the radioactive properties of a number of their isotopes have been determined. The basic chemical properties of elements 102, 103, 104 (kurchatovium) and 105 (nielsbohrium) were first studied here. Other notable successes of the laboratory which have received worldwide recognition include the discovery of new types of radioactivity, i.e., delayed emission of protons and delayed fission, fundamentally new types of nuclear isometry consisting of differences of shape, and a new type of nuclear reaction, i.e., highly inelastic processes in the collision of complex nuclei.

The search for new elements continues, with attention focusing on those with atomic numbers above 107. Current theoretical conceptions of nuclear structure suggest that there should be relatively stable elements, i.e., elements with long radioactive decay half-life, in this range. The experimental proof of the existence of such superheavy elements would be of great importance for nuclear physics and chemistry as a confirmation or refutation of a number of theoretical ideas. It is of course not impossible that these components exist in trace quantities in nature as well, and so, in addition to attempts at synthesis, considerable attention is being devoted to the analysis of natural materials.

The Laboratory of Nuclear Reactions is currently working on the technical development of accelerators. It suffices to note that the U-400 cyclotron, whose magnet weighs about 2,000 tons, was manufactured almost completely in the SUJV, with laboratory staff members taking the main role in computations, design, construction and installation; this also made it possible to make running changes and improvements in design details. The whole unique device was built in 3 years and put into operation at the end of 1978. It should also be noted that the sympathetic attitude of Czechoslovak plants, which delivered certain necessary machines on short schedules, contributed to the success of the undertaking.

The Laboratory of Nuclear Reactions is devoting considerable attention to the use of the methods of nuclear physics and chemistry in engineering. It is engaged in simulating damage to materials in breeder reactors, studying the effect of heavy-ion irradiation on the mechanical properties of metals and the like. Particular attention is being devoted to the production of so-called "nuclear filters" by chemical etching of plastic films irradiated with a beam of heavy ions. This produces membranes with openings ranging from several hundredths of a micron up, with all channels having exactly the same size, making this product superior to all previously-known types of filter membranes. Nuclear filters have extensive potential for use, and their production by the procedure described is extremely inexpensive.

The laboratory has also built a compact electron accelerator (microtron) and has developed a number of procedures for activation analysis of various materials using gamma radiation and neutron beams produced by conversion of a primary electron beam. Two new, more powerful devices of this type are being built in cooperation with CVUT in Prague. One will be installed in Prague and the other in Dubna; they are expected to become operational in a few months. The microtron offers considerable potential for express analysis of the ores of rare metals and for determining the nitrogen content of biolocal specimens and the like.

Czechoslovak specialists are taking a particularly important part in the chemical research being conducted in the laboratory. Currently, our republic is represented in the laboratory by one member of UJV [Institute of Nuclear Research] CSKAE on long-term assignments as section chief.

The Laboratory of Neutron Physics

This laboratory was founded in 1956. It currently employs more than 500 persons, including 3 doctors and about 45 candidates of science. The laboratory director is an Academician of the USSR Academy of Sciences, I. M. Frank, a Nobel Prize winner.

The main equipment of the laboratory is the IBR-30 and IBR-2 pulsed fast-neutron reactors, which by their conception and characteristics are unique neutron sources. Thanks to a method based on the analysis of neutron time-of-flight, both reactors can be used as multipurpose neutron spectrometers with high resolution and brightness. This is also their main advantage compared with powerful steady-state reactors intended for physics research. The promise of pulsed reactors has been shown by a body of physical data obtained during the 20 years of operation of the IBR-30. The qualitatively new plutonium-fueled, liquid-hydrogen-cooled IBR-2 reactor is currently in the power production startup stage. Its average power will be 4 MW, i.e., about 100 times that of the IBR-30, while the pulse power will reach 8 GW. It is expected that a number of demanding experiments requiring a high slow-neutron flux will become possible with the new reactor.

An additional promising device, the LIU-30 linear inductive electronic accelerator, is under construction. The current of the electron beam in this accelerator will reach 250 A in 1-microsecond pulses, with electron energies of 30 MeV. It is expected that this device will operate in connection with the IBR-2 reactor. The electron beam will be used for pulsed generation of neutrons, which will then be multiplied in the reactor core. A combination of this type has turned out extremely well in the case of the IBR-30 reactor and the LUE-40 electron accelerator.

The scientific activity of the Laboratory of Neutron Physics is concentrated in the following areas: investigation of atomic nuclei by neutron spectroscopy, investigation of the fundamental properties of the neutron, use of neutrons to investigate the atomic structure of condensed matter and, of course, applied research.

Its research in nuclear physics primarily involves the detailed study of neutron resonances occurring during the interaction of slow neutrons with nuclei. For a number of years, the laboratory has been systematically measuring resonance parameters, making various polarization measurements, studying the isomeric shifts of resonances, measuring their magnetic dipole moments and the like. Important information on the structure of the nucleus has been obtained by the study of various neutron resonance decay paths. The laboratory has obtained particularly many original experimental results in the study of alpha decay of isolated resonances. In addition, the laboratory has studied the fission of heavy nuclei by slow neutrons for many years in order to gain a detailed understanding of the mechanism of this reaction.

The experiments on interactions between neutrons and electrons involve the fundamental properties of the neutron. In the next few years, an experiment aimed at finding the electric dipole moment of the neutron will be performed. The TRISTOM equipment to be used for this purpose is currently being installed on the beam of the IBR-2 reactor. The promise of this and similar experiments involves primarily the physics of ultracold neutrons. The Laboratory of Neutron Physics has played a decisive role in this area. Ten years ago it succeeded in demonstrating the existence of ultracold neutrons and the possibility of extracting them from the reactor moderator. Fundamental research in neutron optics will become possible with the DIFRAN device which the laboratory is preparing at the initiative of Czechoslovak specialists.

In the physics of condensed matter, the laboratory is investigating the structure and dynamics of solids and liquids through elastic and inelastic scattering of slow neutrons. New diffraction methods involving analysis of the flight time of neutrons have been worked out. Considerable successes have also been achieved in the study of quantum effects in liquid helium and investigation of the properties of molecular crystals. Small-angle neutron scattering has been used to determine the structures of various biological specimens. Recently, biomedical research using slow and fast neutrons has been expanding.

Currently, nine Czechoslovak workers on long-term assignment from the Institute of Nuclear Physics, CSAV in Rez, FJFI [Department of Nuclear and Physical Engineering], CVUT in Prague, the Institute of Physics of SAV in Bratislava, Komensky University and other organizations have been working at the laboratory. Cooperation is arranged so that the results obtained at the laboratory and at domestic organizations complement each other. Czechoslovak personnel in the laboratory are working on the following tasks:

1. radiative capture of resonance neutrons;
2. fission of heavy nuclei by resonance neutrons;
3. neutron optics and its applications;
4. use of neutrons for research in the physics of condensed matter and molecular biology.

The Laboratory of Data Processing and Automation

This laboratory is relatively young, having been founded in 1966. Currently it has 570 workers, including 4 doctors and 32 candidates of science. The laboratory director is M. G. Meshcheryakov, Corresponding Member of the USSR Academy of Sciences.

The need for creation of the laboratory stemmed from the rapid increase in the quantity of experimental data and the need to process the data effectively. Equipping the individual laboratories with their own computer equipment proved ineffective. The new laboratory had the mission of seeing to most of the institute's data processing equipment, including technical maintenance and provision of software support. It was also assigned the task of developing means of automating physics experiments and processing data, as well as the mathematical solution (primarily by numerical methods) of physical problems.

Currently the computer complex of the Joint Institute consists of more than 50 stand-alone computers of various sizes. Most important among them are the large BESM-6 Soviet-produced computer and a CDC-6500 (produced in the United States), whose total capacity is about 2 million operations per second. The medium-sized and small computers, primarily from the CEMA Unified System of Electronic Computers [JSEP], are located in the laboratories' measurement centers, where they are used for direct control of individual experiments and for preprocessing of experimental data. Most of them are connected to the BESM-6 computer.

In recent years it has been possible to considerably expand the internal memory of the BESM-6 computer by means of JSEP-5061 magnetic disk units, so that it now has a capacity of 290 Mbyte. A multiplexor and telegraph channel adapter has been developed and debugged for the JSEP-1010 computer, making it possible to connect a total of 16 terminals to the BESM-6. The CDC-6500 computer is used exclusively to solve large-scale problems and process large data sets. Both main computers are in operation about 7,000 hours a year. The laboratory is carrying on systematic research work aimed at modernizing the computers and improving the effectiveness of their operation and is developing methods of visual display of data and interactive interfacing ewith the computer. In addition, the software of the various types of computers is being improved.

Initially, the laboratory concentrated its attention on automating photography in the track detectors (bubble or spark chambers and the like). Equipment for examining the photographs and devices for processing them semiautomatically or automatically were designed and produced. Currently, 20 scanning devices and 15 semiautomatic and 4 automatic devices for making measurements on track-detector photographs are available. The system includes the SAMET semiautomatic scanning and measuring apparatus produced by FZU CSAV in Prague.

Experiments in nuclear and high-energy physics have come to use more and more electronic detecting equipment in on-line connection with the computer. As a result the role of microprocessors in automating physics experiments has considerably increased.

A television system for monitoring the operation of the 5-meter streamer chamber and equipment for digital recording of track coordinates in the chamber and their entry into the memory of a JSEP-1040 computer were developed for the RISK project.

The Laboratory of Data Processing and Automation is developing new mathematical methods for solving specific problems of theoretical and experimental physics and is improving existing computation algorithms. Much of this work is important not only for immediate use but for mathematical theory in general. For example, methods of solving nonlinear equations and numerical solutions of problems in mathematical physics and plasma physics are being studied, and the mathematical simulation of physical processes is being improved. In addition, systematic attention is being devoted to accelerator and nuclear reactor design computations and the like.

A subsidiary but by no means unimportant area of the laboratory's activity is automation of many types of activities associated with management of the institute: wage and materials accounting, inventory management and the like. Currently two Czechoslovak workers are on long-term assignment to the laboratory, in addition to which some of our physicists operating in other laboratories at the institute maintain close contact with the laboratory.

The Laboratory of Theoretical Physics

This laboratory was founded in 1956. From its initial small collective grew one of the largest theoretical physics organizations in the world. Currently, the laboratory has about 160 scientific personnel, including 27 doctors and about 77 candidates of science. The laboratory manager is N. N. Bogolyubov, Academician of the USSR Academy of Sciences.

The laboratory's research program can be divided into three main areas: theory of elementary particles, theory of the atomic nucleus and theory of condensed matter.

In the physics of elementary particles, the efforts of the laboratory personnel have traditionally been concentrated on quantum-field theory with reference both to its internal structure and to its implications for the phenomenology of elementary particles. In the first years of the laboratory's existence, important results were obtained in the area of dispersion relations. During a long period these governed further development of theory worldwide, particularly in the field of strong interactions. Personnel of the Laboratory of Theoretical Physics also made a major contribution to the development of the mathematical bases of quantum-field theory. Among specific contributions we may cite the method of renormalization groups and the development of nonlocal, nonlinear and nonrenormalizable field theories. A new approach to problems of scattering theory, the so-called quasipotential method, was worked out in detail. Pioneering results in the symmetry of elementary particles and in dynamic quark models were obtained. A school studying the geometric properties of space-time at extremely short ranges grew up and is functioning successfully at Dubna. Recently, intensive work has been conducted in calibration theories and in quantum chromodynamics, a promising theory of strong interactions, as well as in the unified theory of electromagnetic and weak interactions. Attempts at a "grand synthesis," i.e., the creation of a theory which would allow the description of small and electromagnetic-weak interactions in the same fashion, are attracting attention, as is work in the quantum theory of gravitation, new, more profound study of the mathematical bases of field theory and other problems in whose solution the laboratory personnel are taking an important part.

Investigations in nuclear physics involve the structure of the atomic nucleus and the mechanisms of nuclear reactions. Theoretical methods of quantum physics and the theory of superconductivity have served as the basis for a microscopic model of the atomic nucleus which, by means of the so-called "Bogolyubov transformation," takes account of the tendency of a neutron-proton pair to create paired aggregates with zero angular momentum. This theory has made it possible to understand the essence of quasiparticle and collective states of the atomic nuclei and their dynamic and static properties. The laboratory has also obtained theoretical results of importance for understanding the mechanisms by which individual nucleons and complex objects (e.g., heavy ions) interact with nuclei. Recently, major efforts have been devoted to developing a theory of the scattering and capture of light particles (electrons or muons) and mesons (pions and kaons) in interactions with nuclei. This work has shown a universal mechanism of nuclear response, i.e., the occurrence of collective nuclear states or "giant resonances," exists for an extensive class of reactions.

Almost 15 years of work in the three-body problem has enabled the theoreticians of Dubna to forecast a catalytic reaction, the acceleration by an order of magnitude of the fusion of deuterium and tritium nuclei in a medium containing muons. The basic physical mechanism of this "muon catalysis" was experimentally confirmed in 1979 by the Laboratory of Nuclear Problems and could lead to a fundamentally new method of commercial energy production.

The group of workers in the laboratory dealing with the theory of condensed matter is small. Organizationally it is attached to the department of phsics of the atomic nucleus. This group is studying phase transitions, problems of magnetism, the physics of crystal lattices and the like.

As a theoretical organization, the laboratory has a rather extraordinary position in the institute. It might appear that this would eliminate the factors which make cooperation so favorable for the small member countries in other laboratories, particularly the opportunity to use expensive, unique experimental equipment. But many years of experience confirms that constant work contact with the international collective of the laboratory is considerably increasing the effectiveness of research in Czechoslovak organizations. The two-sided interest in maintaining and deepening technical contacts is also manifested in agreements. For example, an agreement between the Laboratory of Theoretical Physics and UJF [Institute of Nuclear Physics] CSAV for joint research on meson-nuclear processes and an agreement between the laboratory and the Nuclear Center of MFF UK for joint research on algebraic and functional-analysis methods in quantum-field theory have been signed.

Currently, eight Czechoslovak workers on long-term assignment from UJF CSAV, the Department of Mathematics and Physics of Charles University, and FU [Institute of Physics] CSAV are working in the laboratory. They represent Czechoslovakia in accomplishing the main tasks of the laboratory. The success of this cooperation is attested, for example, by the considerable Czechoslovak participation in which collectives have been awarded prizes for the best scientific work in the SUJV. The tradition begun by Academician Vaclav Votruba, the Nestor of Czechoslovak theoretical physics, is thus being successfully continued.

The Department of New Acceleration Methods

This department was founded in 1968. Currently it has about 400 personnel, including 2 doctors and 12 candidates of science. The director of the department is V. P. Sarantsev, Doctor of Physical and Mathematical Sciences.

The basic task of this department is the development of fundamentally new methods of accelerating charged particles. In the "collective" accelerator, heavy particles (protons and ions) are captured by an electron ring and are accelerated along with the electrons, so that the heavy particles acquire about 50 times more energy than if they were accelerated by themselves in a field of the same intensity.

During the first stage of the work, the department designed models of a heavy-ion collective ionizer. For this purpose it constructed a powerful electron accelerator, several types of "adhesators" (devices creating the ring) and other equipment. In 1969 the first electron ring was obtained with the adhesator. In 1976 a prototype collective accelerator was put into operation; this imparted an energy of 4 MeV per nucleon to nitrogen ions. Following the successful experiments with this prototype, in 1980 the project for a linear collective heavy-ion accelerator in which the ions would attain an energy of 20 MeV per nucleon was approved. On the Czechoslovak side, UJF CSAV in Rez and the Institute of Electrical Engineering, SAV, Bratislava are cooperating with the department. Each of these organizations is currently represented by one member on long-term assignment. This cooperation extends to the following tasks:

1. investigation of the formation, compression and preacceleration of the electron rings;

2. investigation of electrodynamic acceleration of the electron ring.

The Institute of High-Energy Physics

This institute belongs to the USSR State Commission for Peaceful Uses of Atomic Energy and is located in the town of Protvino, near Serpukhov, about 130 km south of Moscow. This is a Soviet national laboratory, but by agreement it makes extensive experimental opportunities available to the physicists of the Joint Institute.

In 1967, a synchrophasotron accelerating protons to 76 GeV and producing beams of secondary particles with a wide range of energies was put into operation there. Among the major successes achieved at the very beginning of the device's existence was experimental proof that the total effective scattering cross section of protons by protons increases with the collision energy and the confirmation of the existence of nuclei of antitritium and anti-^{3}He. In recent years the attention of the physicists in Protvino has been devoted primarily to the problem of the quark-parton structure of hadrons (strongly interacting particles), to experimental verification of the results of quantum chromodynamics and the like. The institute carries out its experimental program in extensive international cooperation with leading foreign institutes working in high-energy physics, such as CERN in Geneva, the French National Nuclear Research Center in Sacalay, the Fermi Laboratory in Batavia, near Chicago, and so on.

The cooperation with the SUJV, already mentioned, plays an important role in the system of cooperative activities of the Institute of High-Energy Physics. The physicists of the Joint Institute are carrying out a number of complex experiments on the beams of accelerated particles from the synchrophasotron in Protvino. For example, currently 15 large devices or sets of apparatus built by the Joint Institute are installed at Protvino.

In recent years, problems associated with further expansion of the experimental facilities have been discussed in detail by the Institute of High-Energy Physics and the SUJV. The result of this analysis was a proposal to build a new accelerator which would accelerate protons to energies above 1,000 GeV. With this accelerator it would be possible to create beams of various types of secondary particles. The high intensity of the proton beams (about 6 x 10^{11} particles per pulse) would make it possible to produce not only the traditional beams of pions and kaons, but also beams of "exotic" particles such as sigma hyperons and other hyperons, neutrino beams and the like. The experimenters would thus gain new, extraordinarily broad opportunities. The project calls for the creation of an additional storage ring in which it would be possible to accumulate and accelerate not only protons but electrons or antiprotons, and thus to create colliding beams of various types of particles.

The project offers the prospect of more profound study of the laws of the microworld, raises the maximum attainable energies and also makes it possible to study the interaction of elementary particles at smaller time-space distances than before. The Presidium of the USSR Academy of Sciences and the Soviet government have agreed to begin construction of this accelerator complex. The work is expected to be completed in 1988. Even now the detection system for experiments on the new accelerator are being prepared at Protvino and in the SUJV, and the problems which this installation would help answer are being formulated.

A Brief Word on the Prospects for Development of the Joint Institute

The Assembly of Plenipotentiary Representatives and the Scientific council of the SUJV devote constant attention to questions of the further development of the institute and its international cooperation. Recently a general plan for the development of the institute through 1990 was prepared, discussed and approved.

According to this plan and the plan for the next 5-year period, the next few years will be marked by a qualitatively new stage in basic research on the structure of the atomic nucleus, the physics of elementary particles, and condensed matter in the SUJV. It will make the fullest possible use of such newly-constructed unique devices as the IBR-2 pulsed reactor, the U-400 isochronous cyclotron and the large-current cyclotron, allowing investigators from the socialist countries to pursue research at the highest international standards.

The most important project of the next five-year plan will be the beginning of construction of the ion accelerating complex in Dubna. This installation will determine the direction of development of physical research in the SUJV for several decades to come. This accelerator will be built with the cooperation of the Kurchatov Institute of Atomic Energy in Moscow. Also of importance will be the SUJV's cooperation in the construction and use of the accelerator and storage complex which the USSR will begin to build during the next five-year plan at the Institute of High-Energy Physics in Protvino.

Czechoslovak scientists and engineers will continue to contribute to the successful fulfillment of the SUJV's tasks. The idea of concentrating our participation on selected critical scientific research programs at the SUJV and of establishing organizational connections with programs in the Czechoslovak State Plan for Scientific Research have justified themselves. The preparation of the next five-year plans by the SUJV and in Czechoslovakia has offered further opportunities to strengthen international scientific and technical integration in the basic research coordinated by the Joint Institute.

Prizes of the Joint Institute of Nuclear Research for Best Scientific Research Awarded to Collectives with Czechoslovak Participation

1. Development of a method for studying elastic scattering of protons and high-energy pi mesons by protons and nuclei in the Coulomb interference range, discovery of constructive interference in proton-proton scattering, and investigation of the relationship between the real part of the amplitude of elastic proton-proton scattering and the energy (1964; Czechoslovakia was represented in the group of authors by J. Korbel and L. Rob).

2. Chemical properties of element 104 (1965; I. Zvara, T. Tvarova).

3. Investigation of the properties of ground and excited states of strongly deformed rare earth nuclei (1966; M. Finger, H. Hnatowicz, J. Urbanec, V. Zvolska, T. Zvolsky).

4. Proposal and development of a new method for measuring the effective resonance mass using a two-channel system along with existing film-type spark chambers and Cerenkov gamma spectrometers, and discovery of electron-positron decay of vector mesons (1967; J. Hladky).

5. The 100-cm hydrogen bubble chamber of the Laboratory of High Energies, SUJV (1968; M. Maly).

6. Alpha-decay of neutron nuclear resonances (1970; M. Florek, J. Kvitek, I. Wilhelm).

7. Cerenkov radiation and its use in high-energy physics (1970; C. Musikar, P. Pavlovic, P. Sulek).

8. The LUDMILA experimental installation for experiments in the Institute of High-Energy Physics, Protvino (1976; S. Vyskocil).

9. Giant resonances in the interaction of medium-energy particles with light nuclei (1977; M. Gmitro).

10. Study of the interaction of pions with small nucleon systems (^{3}He and ^{4}He nuclei) (1977; R. Mach).

11. Investigation of the electromagnetic form factor of pions in quantum chromodynamics by means of dispersion relations (1978; S. Dubnicka).

12. Neutronographic study of crystal structures by measuring time-of-flight (1978; M. Dlouha).

13. A physical complex for studying the decay of short-lived radioactive nuclei, oriented toward very low temperatures (SPIN experimental installation) (1978; J. Dupak, M. Finger, Z. Janout, J. Konicek, J. Rikovska).

14. Fissile neutron-deficient isotopes ^{127}I and ^{167}Tm for nuclear medicine (1978; O. Knotek).

15. An isochronous cyclotron with variable energy (1979; J. Bejsovec, Z. Trejbal).

16. Microprocessor systems in the CAMAC system: development and practical utilization in physics experiments (1979; K. Piska).

8480
CSO: 2402/15

BRIEFS

HEATING FROM NUCLEAR PLANTS--Waste hot water from nuclear power plants V1 and V2 in Jaslovske Bohunice will heat residential areas and industrial plants in Trnava, Leopoldov, Piestany and Nove Mesto nad Vahom. The town of Hlohovec will receive heat in form of steam, from a 600 MW source, which will be utilized by national enterprise Slovakofarma and in fodder production. Other recipient of the heat will be the agricultural and food industry complex in the area of Jaslovske Bohunice, which will utilize it in plant and livestock production. Construction work on the first 22 kilometers of this system is slated for 1983. [Prague ZEMEDELSKE NOVINY in Czech 11 Feb 82 p 6]

CSO: 2402/33

CROATIAN OFFICIAL DISCUSSES SCIENCE, TECHNOLOGY LAG

Zagreb VJESNIK in Serbo-Croatian 13 Feb 82 SEDAM DANA supplement pp 4-5

[Article by Nino Pavic: "Success Cannot Be Achieved by Ordering It"]

[Text] The necessity of going onto world markets, the export orientation of the Yugoslav economy and the certainty that we can establish a foundation for further development only by relying on our own potential rather than through the excessive purchasing of foreign licenses, patents and processes have once again, as back some 10 years or more, made science and technology attractive functions in society.

Two weeks ago the Croatian Assembly adopted the Resolution on Scientific and Technological Policy in SR [Socialist Republic] Croatia. For scientists and people who are concerned with the policy governing scientific and technological progress the decision of the Assembly was a sign of support, but much more tangibly than that, the funds earmarked for these purposes have even this year been increased by about 70 percent. A piece of news that is almost improbable, but only for those who shove science into the domain of "nonproductive investments." To those familiar with world economic development and those who are quite aware of the almost infallible rule of the advanced countries that the benefits of production increase in proportion to investments in development, this measure is simply a stabilization measure.

"What is being allocated to science through the SIZ's [self-managing community of interest] is only a portion of the resources. A sizable potential is also hidden within work organizations. Although we will be using a large portion of the resources we now have at our disposition for science to stimulate research work within enterprises, we still have to wage a fight for considerably larger direct investments. This is a condition for economic survival in the coming medium-term period," says Dr Uros Perusko, professor and chairman of the Croatian Republic Committee for Science, Technology and Information.

"Of the 1.62 billion dinars which have been made available to science this year, we will spend 5 percent to encourage the work and hiring of young scientists and 10 percent to develop science in the regions. The average age of scientists is getting older and older. We will also be vigorous in undertaking to reduce that age and to open up prospects for younger people. It is not enough to furnish someone a job, though even that can be a problem. We have to furnish the young people instruments, supplies and the opportunity to participate in significant and attractive research."

Benefits Clouded Over

[Question] That means that the material status of our scientists could soon be corrected. Often their earnings have lagged behind those in the economy.

[Dr Perusko] Yes, but experience indicates that those are not the decisive questions. People do not decide to take up the challenge of research because of money. It is much more important to provide conditions for scientific work. Our scientists do not live well, but nor do they live much worse than the other working people. The critical point is up-to-date equipment and supply.

[Question] The Federation of SIZ's for Science of Yugoslavia recently proposed that awards no longer be presented to researchers and innovators, but that they participate in a share of the profit.

[Dr Perusko] As a matter of fact this is a worldwide problem of protecting intellectual work and its results. This is not so simple, since there are no precise scales by which it is truly possible over a long period of time to measure a scientist's performance. Rade Koncar, for example, and we should not forget that research work has been organized in an almost exemplary way in that organization, has decided to monitor the benefits of innovations for only 2 years after a new product is put into production. They established that inflation and altered market conditions so cloud over the effects that there is no point in monitoring them. As a rule the results of a scientist's work lie in past labor rather than in present labor. That is why a portion of a scientist's earnings ought to be current, but the other should depend directly on the results of his labor. But those results are difficult to establish, especially in basic research, where the benefits are discovered only several years later.

Success is never certain in scientific research, regardless of how much money is invested. Success cannot be achieved by ordering it. A great deal of patience and long-term investments are needed for us to be able to hope for any sort of results.

[Question] The effectiveness of science depends in large part on the concentration of potential at the key points of development. Have we today in Croatia and Yugoslavia defined the priorities in scientific research?

[Dr Perusko] There is not yet an altogether precise agreement on this. It is well known that in Yugoslavia we still need to adopt a social compact on the strategy of technological progress. The republics have drafted their own plans for development of science over the next 5 years. It is not enough to say that we will take food, say, as a strategic line of development. A very precise agreement is needed as to which projects must be carried out in this field. We are especially interested in those which can be carried out quickly or those which already promise application. That is why we will support, for example, a method of producing alumina from bauxite with high silicon content which has already been patented. That means from poor quality bauxite, which is precisely the bauxite we possess. There are other interesting projects in the field of mariculture, certain research with zeolites offered by Rudjer Boskovic, and so on. At present we are still defining priorities. Our intention is more to speed up work on promising projects, to furnish them funds, equipment and staff.

If there are priorities in the world in the field of technological research, then those fields are computers and biotechnology. We are especially interested in biotechnology, since we have the people, initial success and funds for that research. In that field we have some chance in the worldwide race. The investments are not so large that we could not keep pace with our own financial and economic potential.

Exporters of Intelligence

[Question] However, the development of the electronics industry in Croatia is stagnating. There is no mention at all of computer production, though certain other republics have already done quite a bit. We cannot develop without electronics. What will our republic undertake to change that?

[Dr Perusko] That is an enormous problem. The highly developed countries employ about 50 percent of their manpower in the field of processing information. That development is continuing. The trend is formidable. Mastering the technologies of processing information is truly becoming the key question of progress. And what we call physical production is today based on the processing of information. Failing to keep pace with that kind of world development means lagging behind. As with many other things, Croatia has excellent predispositions, but we have not done much to organize production ourselves. However, there is one fact that favors us. Over the last 30 years or so the prices of physical components of computers have dropped to less than one-tenth what they were. The price of mental labor, however, has dropped to only one-third or one-fourth what it was. So, human labor is being valued more and more, and that is our chance. We have the people and the potential. Today software is being exported just like ordinary products are exported. Even Croatia is exporting software. Jugoturbina, RIZ [Zagreb Radio Industry], the School of Electronics at Zagreb University in collaboration with certain Slovenian firms, Nikola Tesla, and others have become exporters of intelligence. But that is not enough. There must be a point of support in material production, there must exist some concrete product, some fruit of our own mind, with which we can compete on the foreign market.

Of the hardware components of the computer, then, those physical components, the only things we do not produce are semiconductors with a high degree of integration. They are manufactured only by one country in the world, and that at a single site, in California. It does not pay to produce them, since they constitute a small portion of the computer's cost, but mastering production would necessitate excessively large investments. However, we are capable of producing other components, for example, disks and printers--TRS [computer factory] has already achieved world quality in its products. We are also producing the simplest things--visual display terminals, power sources, housings, and so on. Rade Koncar's new locomotive is proof that we can produce even the most complicated things. Though the hardware was purchased in Sweden, the software--the control system, is the result of work by our own specialists.

There are two things, however, blocking the way to more serious development of the electronics industry: integration and development. The world electronics industry appropriates 10-15 percent of the total value of its output for development. Our producers, on their own and separate from one another, cannot do this. Research is expensive, and those who are weak and small cannot run the risk. What makes the transnational companies strong is precisely this joint investment in development, purchasing, sales and marketing.

The example of Belgium is interesting. Recently that country has undertaken political decentralization and regionalization. But one of the elements in common and which was not even disputed, were investments in R&D. Or, take the policy of the new government in France. They are significantly speeding up investments in science and development. A ministry for science and technology, which France never had before, is being established.

Ideal Equilibrium

[Question] That means that government investments in science are growing.

[Dr Perusko] Yes, and that, too, is very interesting. Government investments are growing, but not only in government factories, but also private ones. Our method of pooling capital is too haphazard. The Yugoslav community obviously cannot function without joint investments in R&D. The independence of the republic or nationality in culture or language is one thing, but without a joint effort and community consensus in technology, we cannot progress. Of course, that need not be on a governmental basis.

[Question] It is thought by some that in past years we have neglected basic research quite a bit. The undefined status and prospects of the Rudjer Boskovic Institute are usually mentioned as evidence of that.

[Dr Perusko] That institute is unquestionably our largest resource. Since it gave up its consistent nuclear program more than 10 years ago, the institute has been wandering and seeking its place. If we had not given up at that time, today we would be exporters of nuclear technology rather than importers. Certain components of the institute have found their place by working on specific projects and problems. They had been working for Rade Koncar, Jugoturbina, Pliva, and many others. So, there is a readiness for the institute to be involved in technological advances in addition to basic research. However, not a single institute in the world, nor Rudjer Boskovic either, can take over the job of the economy. All it can do is to finalize some discovery to the threshold of practical application. Then things pass into the hands of the experts in the economy. They must prepare production and take advantage of a certain experience. Everything that is being done in the institute today is nevertheless too petty and small. It is time for us to draft a much more ambitious and consistent plan of its work covering a longer period of time. We must relate our ambitions in development to that institute....

[Question] ... And its basic research?

[Dr Perusko] Certainly. But we must guarantee the ideal balance with applied research. We are too poor to get involved in a large number of basic research projects. And even if we were able to bring them to final form, we would not have the economic resources to take them over, and then they would be used by others. Likewise we cannot throw ourselves exclusively to applied research, since without basic research that is impossible.

Ties With Europe

At the moment we are also working on a project of the International Institute for Molecular Genetics which is to be established in Split. In that field we have excellent research, tested personnel and large opportunities. This would be a center of the "transient" type. It would have laboratory and living facilities. We would organize work in it in such a way that the specialists would remain at the institute only while they were working on the project. Many scientists with a world reputation have announced that they would participate in this project. The center has been discussed by the Presidency of SR Croatia, the Executive Council of the Croatian Assembly, the Yugoslav Academy of Sciences and Arts, and so on. They have all given us support. The staff and money have been furnished. It should not be forgotten that this is one of the most promising fields of science in the world.

[Question] If one is to make a breakthrough in the world, one must also be informed about scientific and technological innovations in the world. Some of the republics are setting up their own information systems, and even certain large work organizations like Energoinvest have done quite a bit on this. What is being undertaken by Croatia?

[Dr Perusko] We dare not suppose that we will solve all the problems with a single unified information system, though some people do have illusions about that. For the moment we must develop the individual parts and fit them into a unified network. The national library and university library, as you know, have a patent file, Radio-TV Zagreb is working on its information system, and so on. At the initiative of the Federal Executive Council a plan has been drafted for our inclusion in Euronet, the European information network, which could provide practically all the most recent data on research, markets, production, and so on. We want Zagreb to be the experimental point of Yugoslav inclusion in that system. Vojvodina has a very good information network for data in the field of agriculture and agricultural technology.

Today we are still very far from having too many information systems. We are just in the stage of building them. But what especially disturbs us, unfortunately, is far from computers. Today we are in a situation where we cannot furnish our scientists even the basic working tool--specialized literature. The Executive Council of the Croatian Parliament has issued three appeals to the commercial banks and the SIZ for Foreign Economic Relations for them to finally approve the funds for purchasing books and periodicals in the world outside. So far there have been no results, and yet the amount involved is insignificant.

7045
CSO: 2802/3

END

END OF FICHE

DATE FILMED

MARCH 15, 1982